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L19: Entry 1 of 1 File: USPT Dec 16, 2003

US-PAT-NO: 6665273
DOCUMENT-IDENTIFIER: US 6665273 B1

TITLE: Dynamically adjusting multiprotocol label switching (MPLS) traffic engineering tunnel bandwidth

DATE-ISSUED: December 16, 2003

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Goguen; Robert	Acton	MA		
Swallow; George	Concord	MA		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
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APPL-NO: 09/ 482968 [PALM]
DATE FILED: January 11, 2000

INT-CL: [07] H04 L 12/28

US-CL-ISSUED: 370/252; 370/377
US-CL-CURRENT: 370/252; 370/377

FIELD-OF-SEARCH: 370/412, 370/389, 370/469, 370/252, 370/377

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

	PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
☐	5623492	April 1997	Teraslinna	370/397
☐	5953338	September 1999	Ma et al.	370/377
☐	6262989	July 2001	Gemar et al.	370/412
☐	6519254	February 2003	Chuah et al.	370/389

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
2374243	September 2002	GB	
2374243	October 2002	GB	

OTHER PUBLICATIONS

"Multiprotocol Label Switching," Packet Magazine Archives, Second Quarter 1999.
Davie, "Multiprotocol Label Switching--Service Providers to Benefit from New Functionality," Packet Magazine Archives, Second Quarter 1999.
"Multiprotocol Label Switching (MPLS) Traffic Engineering," Cisco Systems, Inc., 1989.

ART-UNIT: 2661

PRIMARY-EXAMINER: Cangialosi; Salvatore

ATTY-AGENT-FIRM: Cesari and McKenna, LLP

ABSTRACT:

A method and apparatus for an improved Multiprotocol Label Switching (MPLS) system for traffic engineering is described. The improved MPLS system determines the actual traffic flow within a traffic engineering (TE) tunnel and dynamically adjusts the bandwidth to reflect the actual traffic flow. The actual traffic flow may be ascertained by accessing an average byte counter, which keeps track of the traffic flowing through the TE tunnel. Once the actual traffic flow is known the bandwidth is updated in accordance with the actual traffic flow. This allows the MPLS system to automatically maximize the bandwidth resources while minimizing operator intervention.

45 Claims, 12 Drawing figures

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☐ 1. Document ID: US 6665273 B1

L19: Entry 1 of 1 File: USPT Dec 16, 2003

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TITLE: Dynamically adjusting multiprotocol label switching (MPLS) traffic engineering tunnel bandwidth

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INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Goguen; Robert	Acton	MA		
Swallow; George	Concord	MA		

US-CL-CURRENT: 370/252; 370/377

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D

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Term	Documents
CONSTRAINT	38451
CONSTRAINTS	74305
(18 AND CONSTRAINT).USPT.	1
(L18 AND CONSTRAINT).USPT.	1

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DB=USPT; PLUR=YES; OP=ADJ			
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L18	L17 and database	1	L18
L17	tail-end and traffic adj engineering	1	L17
L16	generate adj partial adj path	1	L16
L15	L14 and path adj determination	2	L15
L14	constraint and partial adj path	86	L14
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L12	loose-hop and constraint	0	L12
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L10	determination adj constraint and partial adj path	0	L10
L9	L8 and loose adj hop	0	L9

L8	constraint adj processing	223	L8
L7	constraing adj processing and loose-hop	0	L7
L6	constraint adj processing and path adj determination	0	L6
L5	l1 and processing adj constraints	0	L5
L4	l1 and constraint adj processing	0	L4
L3	L1 and constraint	4	L3
L2	L1 and constraint-based	0	L2
L1	processing adj path adj determination	24	L1

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☐ 1. Document ID: US 6721269 B2

L27: Entry 1 of 1 File: USPT Apr 13, 2004

US-PAT-NO: 6721269
DOCUMENT-IDENTIFIER: US 6721269 B2

TITLE: Apparatus and method for internet protocol flow ring protection switching

DATE-ISSUED: April 13, 2004

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Cao; Yang	Bradford	MA		
Buchanan; William M.	Rockingham	NH		
Lefoley; Stephen George	Plaistow	NH		

US-CL-CURRENT: 370/227; 370/244, 370/389, 370/410

Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D

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Term	Documents
CONSTRAINTS	74305
CONSTRAINT	38451
(26 AND CONSTRAINTS).USPT.	1
(L26 AND CONSTRAINTS).USPT.	1

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L27: Entry 1 of 1 File: USPT Apr 13, 2004

DOCUMENT-IDENTIFIER: US 6721269 B2
TITLE: Apparatus and method for internet protocol flow ring protection switching

Detailed Description Text (4):
The conceptual block diagram of FIG. 1 illustrates a multiprotocol label switched routing communications system that employs a router in accordance with the principles of the present invention. The communications system includes label switching routers (LSRs) LSR A, B, C, D, E, F and S. Each of the routers may be an abstract router; that is, it may actually be any one of a plurality of routers within a network in accordance with the principles of the present invention communications from node S to node E may be established employing a plurality of explicit label switched routing paths (ELSRPs) between nodes S and E. Explicit label switched routing paths are known, and discussed, for example, in a Multiprotocol Label Switched Working Group Internet Draft document entitled "Constraint-Based LSP Setup Using LDP", which is hereby incorporated by reference. This, and other Internet draft documents are listed at http:/www.ietf.org/ietf/1id-abstracts.txt

Detailed Description Text (6):
Internet protocol routing is known and discussed, for example, in Douglas E Comer, Internetworking With TCP/IP Volume I, 1995, Prentiss Hall, pages 109 through 121, which is hereby incorporated by reference. In general terms, indirect delivery, that is delivery of a datagram between two machines that are not directly connected together across a single physical network, employs an Internet Protocol (IP) routing table resident on each host or router in the Internet. The IP routing table stores information about possible destinations and how to reach those destinations. The pertinent routing information typically includes the destination's network prefix, not destination host machine or the corresponding full IP address, and the IP address of the "next" router along the path to the destination network. In accordance with the principles of the invention, a plurality of explicitly routed label switched paths, paths S-A-B-E, and S-C-D-E in the example of FIG. 1, are established from the ingress router, that is, router S, to the egress router, router E. Once both paths are established, datagrams are transmitted along both paths, with the egress router choosing the one of the paths as its primary source of datagrams. Should the primary path fail, due, for example to a cut fiber along the S-A-B-E path, router E switches to a secondary route, the S-C-D-E route in this example. In accordance with the principles of the invention, Label Distribution Protocol (LDP) may be employed to support the establishment of a label switched path (LSP), based on explicit routing constraints. Explicit routing constraints provide an end-to-end setup mechanism, including a way of reserving resources using the label distribution protocol of a constraint-based routed LSP (CRLSP) initiated by the ingress LSR.

Detailed Description Text (7):
Explicit Routing is a subset of the more general constraint-based routing where the constraint is the explicit route. An explicit route is represented in a Label Request Message as a list of nodes or groups of nodes along the constraint-based route. When the CRLSP is established, all or a subset of the nodes in a group may

be traversed by the LSP. Certain operations to be performed along the path can also be encoded in the constraint-based route. A constraint-based route is encoded as a series of ER-Hops contained in a constraint-based route Type Length and Value (TLV). Each ER-Hop may identify a group of nodes in the constraint-based route. Consequently, a constraint-based route is a path including all of the identified groups of nodes. For the clarity of exposition, each group of nodes may be referred to hereinafter as an abstract node. A request at an ingress LSR to setup a CRLSP might originate from a management system or an application, for example. The ingress LSR uses information provided by the management system or the application and possibly also information from the routing database to calculate the explicit route and to create a Label Request Message.

Detailed Description Text (30):
Since the ER-TLV was not removed, LSRC is not a member of the abstract node described by the first ER-Hop <SIC>, and the first ER-Hop <S/C> is a strict hop, new hops are not inserted. The selection of the next hop has been already done in step 4 and the processing of the ER-TLV is completed at LSRC. In this case, the Label Request Message including the ER-TLV <S/C, C/D> is passed by LSRC to LSRD. The process continues in a similar fashion at LSRD, with the incoming ER-TLV =<S/C, C/D> and the outgoing ER-TLV <D/E>.

Detailed Description Text (34):
According to the principles of the invention a plurality of Explicit routed label switched paths are established in this manner between the ingress router and the egress router, routers LSRS and LSRE, respectively in the illustrative conceptual block diagram of FIG. 1. The traffic characteristics of a given path include parameters related to peak rate, committed rate, and service granularity. The peak and committed rates define the bandwidth constraints of the path. The service granularity may be employed to specify a constraint on the delay variation a CRLDP MPLS domain may introduce to a path's traffic. Setup and holding priorities may be employed to rank paths and to thereby determine whether a new path may preempt an existing path. An attempt to establish an Explicitly Routed LSP may fail for a variety of reasons and each such failure is classified as an advisory condition that is signaled by a Notification Message. A CRLSP may be cleared through use of Label Release and Label Withdraw messages.

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